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# AIR COMMAND AND STAFF COLLEGE

## STUDENT REPORT

SMALL AND SURE:
A NEW CONCEPT IN THEATER AIRLIFT

MAJOR PETER W. RUSSO 84-2260

*"insights into tomorrow"*

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This article examines the need for an aircraft to replace the C-7 Caribou, which was recently retired from the inventory. In concluding that a new small cargo aircraft is needed, the author suggests three missions which would be served by this fleet. The new aircraft would provide flexibility to the current tactical airlift force, support the strategic airlift fleet, and satisfy the requirement for a European Distribution System aircraft. The article concludes with the author's exhortation of logisticians and airlifters to join in designing a single fleet to satisfy these missions.

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# PREFACE

To be a tactical airlifter today is to fly the C-130 Hercules. Certainly the Herk is a worldwide trash hauler destined to live forever in legends much the same as the DC-3. But there was a time, not long ago, when theater airlift was more flexible and, perhaps, even more responsive. The Military Airlift Command flew small, medium, and large tactical transports, and few strips were too small for the fleet. But the small and medium birds have been removed from the fleet. Today, one size of aircraft performs all tasks in tactical airlift.

The purpose of this article is to inform the public of this development. The Air Force needs a new small airlift aircraft, and the author has suggested three possible missions for such a fleet. Surely, there are other missions for this aircraft. If this article stimulates discussion of this subject, it will have accomplished its purpose. Subject to clearance, it will be presented to the Air Force Journal of Logistics for consideration.

Efforts to develop this article would have been futile without the help of four people: the author's sponsors at Headquarters, Military Airlift Command—Majors Bob Chambers and Stan Rising—and, at the Pentagon, Major Mike Ashmore, provided advice that insured the accuracy and timeliness of the discussion. Finally, Mr. J.C. Smith, the Air Command and Staff College editor, miraculously transformed the article into readable prose for laymen and professionals.

# ABOUT THE AUTHOR

Major Russo is a student at Air Command and Staff College. As a C-130 pilot, he has flown almost 3,000 hours, including more than 50 combat missions in Southeast Asia. His vast tactical airlift experience encompasses the Asian, European, South American, and Alaskan theaters. He is also an air transportation officer with three years experience in managing aerial port operations and transportation plans at RAF Mildenhall, United Kingdom. Most recently, he was an airlift duty controller at 21st Air Force, McGuire AFB, New Jersey. Major Russo has a degree in civil engineering from Manhattan College, a master of science degree in transportation from Northwestern University, and a master of science degree in management from Troy State University. He has completed Squadron Officer School and Air Command and Staff College by correspondence.

# SMALL AND SURE:

## A NEW CONCEPT IN THEATER AIRLIFT

Retirement of the C-7 Caribou from the Air Force inventory is a bittersweet experience. From some quarters come expressions of sadness that the reliable old steed will no longer serve her riders. Other quarters are optimistic that the new beast will bear greater burdens than the old workhorse. When the C-7 Caribou retired from the inventory at Maxwell Air Force Base, Alabama, in October 1983, the C-130 Hercules became the principal cargo aircraft of the 908th Tactical Airlift Group, Air Force Reserve. This aircraft can fly higher, faster, and farther and can carry much more cargo than the Caribou. But, with a payload of 43,000 pounds, it is clearly a large aircraft. The Caribou was the last small cargo aircraft. What has the Air Force lost by failing to replace its small cargo airlifters?

The Caribou, also known as the DeHavilland DHC-4, was first produced for the US Army in 1953. It was a short takeoff and landing (STOL) aircraft capable of operating from unpaved strips less than 1,500 feet long. The original production model could lift 7,300 pounds or 32 passengers, but these heavy gross weights limited its range. The Caribou was also capable of airdropping smaller loads of troops or cargo under combat conditions and was thus the smallest of the tactical airlifters. The Air Force made extensive use of these capabilities during the Vietnam conflict and usually loaded it to 60 percent of its weight capacity. This utilization rate was higher than the rates of the larger tactical airlifters. The Caribou flew mostly routine logistics resupply missions; emergency missions accounted for less than two percent of the sorties. Despite its STOL capability, the

aircraft made only 27 percent of its mission landings on fields less than 2,500 feet in length. Only one percent of the missions flown in the Republic of Vietnam were combat airdrops.[1] This experience suggests that the Air Force has not lost much combat capability by replacing the Caribou with a larger airlifter.

Unfortunately, it has lost a significant degree of flexibility. Three airlift missions can be flown efficiently with a small aircraft. First, there is still a logistics mission for small loads. Second, small theater airlifters are needed to support larger aircraft of the Military Airlift Command (MAC). And, finally, a new, small aircraft is the centerpiece of a revolutionary concept in assuring distribution of theater logistics. In other words, replacement of the Caribou should satisfy requirements for conventional theater airlift, MAC support, and assured distribution.

## CONVENTIONAL INTRATHEATER AIRLIFT

Generalizations about the requirements for airlift within a theater are difficult. In the first place, every theater of the world is physically unique. The distances involved, the number of available airfields, the adequacy of ground transport, and the size of the deployed forces are only a few of the variables in the equation for theater airlift. Nonetheless, some elements are constant. One of these elements is the timely movement and resupply of forces within the theater. To accomplish this mission, the Military Airlift Command is prepared to move forces into battle through airland or airdrop operations. Forces can be resupplied by airdrop much the same as they were resupplied at Khe Sanh, but an established airlift channel is necessary for routine resupply. A channel is simply a route designed to

move passengers and cargo between two points on a regularly scheduled basis. Channel requirements can range from heavy, more than daily service to light weekly service. A fiat of tactical airlift is that every station requires some regularly scheduled service even if it is only to exchange a few sacks of mail for small amounts of cargo. These underused channels are a fact of life in both peacetime and wartime theaters.

Traditionally, this underuse of tactical airlift aircraft has been attributed to the nature of the mission. In testimony before Congress in 1975, General Paul Carlton, the commander of MAC, remarked:

> The low cabin loads generated through small bases and outposts contribute to a distorted picture of airlift capability based on ton-miles....Responsiveness and flexibility to meet fluctuating theater tactical requirements establish the effectiveness for tactical airlift forces rather than ton-mile computations.[2]

The extent to which use of airlift has become less efficient has recently been revealed through a new analysis tool called the Channel Productivity Improvement Program. An unofficial survey of of this report over a three-month period shows that approximately 72 percent of the C-130 channel missions carry less than 40 percent of their capacity.[3] Although some of these missions may have required C-130s because of cargo cube or mission range, a lack of cargo for small stations accounted for most of the empty space. What are the options for solving this problem?

Economy would dictate less frequent service or reduction in the size of aircraft assigned to these underused channels. Less frequent service would allow more cargo to build up at the shipping aerial port and would thus insure fuller airplanes and more economical service. Clearly, this would deprive the deployed units of the primary attribute of airlift service—speed of delivery. One is not surprised that the using command or branch of service determines the frequency of service required for these

low-use channels. Therefore, the only option available to the Military Airlift Command is to provide the service with smaller aircraft. The Caribou provided this service in Vietnam, but similar service would be impossible today because the Hercules is both the largest and the smallest intratheater airlifter. This dilemma could be resolved with the addition of a small airlift aircraft to replace the Caribou.

When commercial airlines in the United States faced similar problems, they abandoned routes of low use and made them available to commuter airlines. In operating large aircraft on heavily travelled routes, the major airlines found that it was not in their financial interest to serve every airport capable of generating a passenger. But, without a system to feed passengers into their major stations, the airlines would leave a substantial number of customers without service. The solution was to employ small, economical turboprop aircraft used by commuter airlines around the country. These companies make a profit in flying the same routes on which companies flying larger aircraft lost money because they provide a desired frequency of service at low cost. Commuter aircraft can carry up to 30 passengers or approximately the same payload carried by the Caribou. A comparison of the operating costs of the Hercules with the costs of operating a typical small aircraft shows the advantages of fitting the airplane to the job.

The C-130 is a large, complex aircraft designed for multiple wartime roles and is thus more expensive to operate than a typical small cargo aircraft, such as the Shorts Skyvan. The Skyvan, a twin turboprop aircraft, uses approximately 600 pounds of fuel for an hour of flight. The Hercules has four engines and burns almost 5,000 pounds per hour. But the Skyvan is a slower airplane that cruises at 160 knots versus 280 knots for the C-130.

Commuter airline operators have found that cruising speed is not a major determinant on a route that serves many stations, since they spend much of their transit time on ground operations, taking off, or landing. The smaller aircraft requires three crewmembers to five required for the Hercules. The C-130's complex systems require 25 maintenance man-hours to keep the aircraft flying for only one hour, but the comparatively simple systems on the Skyvan require only five hours for each flying hour. The C-130 aircraft is fitted with tons of electronic and other equipment necessary for the combat airdrop role, but little of the equipment is needed on routine logistics missions.

The Military Airlift Command now has the opportunity to match mission requirements with the appropriate aircraft. With all of its advantages for transporting small loads, the Caribou was an old airplane that burned aviation gas instead of jet fuel. Years of rugged service had limited its reliability and made it difficult to maintain. Modern proven aircraft, such as the Skyvan, are available for less than $2 million per aircraft. Unmodified or off-the-shelf, these planes could assume the theater logistics role on routes of low use, and free a similar number of C-130s, which currently cost $11 million each, for the airlift role in theater combat. But the small aircraft can make an even greater contribution in the area of MAC support and assured distribution.

## SUPPORT FOR MILITARY AIRLIFT

Intertheater cargo airlift is performed primarily with C-5 and C-141 aircraft that transit many airfields, both in the United States and in overseas areas, to accomplish their mission. Unlike aircraft used by the

commercial airlines, these aircraft are frequently called upon to onload or offload cargo at bases that are not included on the normal route structure maintained by the Military Airlift Command. In such instances, they are isolated from normal maintenance support en route. When an aircraft breaks down at one of these locations and base maintenance personnel are unable to correct the problem, the Military Airlift Command must then support its aircraft from another location, normally by diverting another C-141 or C-130 to a base where maintenance personnel and parts are available. The rescue aircraft is then routed through the base where the broken aircraft is located. If an empty depositioning aircraft is not available, a loaded aircraft is used, and cargo or passengers may be displaced from this aircraft to make room for the maintenance team. The rationale for "bumping" some user cargo for maintenance equipment is that a planeload of cargo will be affected if the broken aircraft is not quickly repaired. Therefore, repair of that aircraft is given a higher priority. This system works well in peacetime operations because aircraft are usually scheduled for large blocks of ground time at home stations between missions and the diversions consume this "slack" time.

Forecasting the magnitude of this support in wartime, however, is difficult for at least three reasons. First, the number of diversions to carry maintenance support in peacetime is not recorded accurately, since many of the diverted planes are trainers or depositioning aircraft. Experience has shown that an average of four such diversions are necessary every day in the eastern half of the United States alone. This figure suggests a conservative worldwide figure of 10 per day. Second, the daily use rate for MAC strategic aircraft is expected to quadruple in wartime from the current 3 hours per day to more than 12 hours.[4] Although the number of

breakdowns at stations en route will increase, it will probably not increase proportionally with the use rate because, in wartime, many aircraft will fly with problems that would ground them in peacetime. Thus, the number of wartime diversions will be somewhat less than 40 per day. Of course, an empirical formula is not available, since the Military Airlift Command has never used its entire fleet under such high use rates. It approached this figure during the 1973 Arab-Israeli conflict when it used 83 percent of its C-5 fleet at an average rate of five hours per day and 36 percent of the C-141 fleet at eight hours per day.[5] Finally, the problem of unsupported breakdowns en route is further complicated by field closures during combat conditions. A study by the Rand Corporation in 1973 notes that a number of strategic airlift sorties will be diverted from their scheduled offload and maintenance bases and that moving support to the recovery bases would be a problem. And the problem is magnified by the questionable availability of C-130s for such movements.[6] In addition to the difficulty of forecasting the number of diversions, such a method of operation suffers from other inherent drawbacks.

For example, the entire routine for support of strategic airlift aircraft en route will face a much more tenuous situation during wartime. Planning for wartime operation is based on maximum use of all airlift resources; that is, aircraft, crews, and airfields are scheduled to get the most value from the resources available. Because of this tight scheduling, breakdowns or other disruptions in the airlift timetable will cause repercussions throughout the system, and little slack time will be available to divert additional aircraft for maintenance support without causing further disruption. Furthermore, airfields with broken MAC aircraft on the ramp provide fewer parking spots, and this will cause further slowing of the

airlift stream. Some means are necessary to provide the required maintenance support rapidly without diverting the flow being supported. The problem of supporting airlift flow has plagued airlift planners since the earliest air supply missions. For example, while Lt Gen William Tunner was conducting airlift operations over the Hump to China during World War II, he expressed dismay that he had to expend so much of his capability just to support his maintenance requirements.

The problem is worse today because there are fewer large transports. Each aircraft represents such a large percentage of the total transportation available that its loss for even a few hours will be more detrimental to the flow. This implies that broken aircraft must be fixed faster and that the opportunity cost of diverting an aircraft to support it will be much greater. Since most of these support teams are quite small - an average of two maintenance personnel, a tool box, and some small parts - an entire C-141 is not necessary to move them. They could easily deploy on a C-130, but most planners consider the C-130 fleet unavailable for additional tasking during wartime because of their deployment and combat airlift requirements. How, then, could small airlift aircraft solve this problem?

During the deployment phase of war when the flow of strategic airlift would be the heaviest, small aircraft similar to the Caribou or the Skyvan would alleviate problems caused by breakdowns in the flow. Most of the required maintenance teams would fit easily on such an aircraft, and, if only two of these aircraft in the theater were designated for MAC support, they could provide maintenance almost on demand. Since a team would not need to wait for a diverted C-141, it would arrive sooner and make the necessary repairs more quickly. Today, the crew of a broken aircraft often waits more than a day for maintenance support, but a responsive, dedicated

aircraft would probably enable the crew to fly the plane out the same day. This improvement would reflect the goal of Tunner and every MAC planner—greater performance from the airlift system.

## ASSURED INTRATHEATER DISTRIBUTION

The Air Force Logistics Command has developed an imaginative plan called assured distribution for increasing the logistics support of tactical air units in Europe. The concept is based on a study by the Rand Corporation concerning the effect of improved redistribution of logistics in the European theater during a war.[7] The Rand study forecast that implementation of assured distribution could generate 600 tactical air sorties per day. Included in the concept are three improvements in the theater logistics system: logistics command and control, in-theater warehousing, and a European distribution system. The first two improvements are major operations in themselves, but they are not germaine to this discussion. The European distribution system addresses the very heart of the argument for new, small airlift aircraft.

As the Rand study points out, the need for this system is based primarily on the redistribution of aircraft parts to meet the unique demands of combat forces. The uncertainty of fighting a war applies most acutely to forecasting resupply requirements because similar units throughout the theater will use parts and supplies at different rates. This discrepancy will lead to supply imbalances or familiar instances of one base having aircraft grounded for parts that are plentiful at another base. To correct this discrepancy, the new logistics concept calls for a command, control, and communications system to discover imbalances and identify the solution.

In-theater warehousing is designed to shorten the supply pipeline, make the units less susceptible to supply surges, and provide the source of parts that will flow through the distribution system. The distribution system itself is not unique in design, but its implications for military airlift operations are revolutionary.

The European distribution system calls for an airlift network to distribute critical aircraft parts throughout the theater. A fleet of small cargo aircraft similar to the Skyvan would operate a scheduled service to every European base in the network on a daily basis. The route structure would permit overnight service between most of the stations in Europe and would resemble the system used by Federal Express in the United States. This system, often called a hub-and-spoke operation, centers around a common redistribution point, the hub. Each day, an aircraft from the fleet visits every airport served by the system and picks up parcels as it makes its way toward the hub. By the middle of the night, all of the aircraft have arrived, and all the parcels have been sorted by destination. After the aircraft are loaded, they depart on their spokes and drop off the cargo through the early morning hours. In this manner, delivery from any station to any other station can be accomplished overnight in most cases.

Some fundamental changes were incorporated into the military system, since it is designed for combat operations. The forward warehouses and hubs are being designed for mobility so that they can be relocated if their security is threatened. The routes can be rapidly revamped to account for unit movements or dispersal within the theater, and the size of the fleet is based on wartime requirements, with a limited distribution network in peacetime. Surging to war operations will involve increasing the use rate and curtailing routine crew training. Even during wartime, the fleet is

designed so that aircraft will be available to support unforecast requirements on a "you call, we haul" basis. Naturally, the design of the aircraft is central to the capability of this system to perform its mission.

The Air Force has written a request for proposal that describes the capabilities needed in the EDS aircraft, which will carry the F100 jet engine as its single largest piece of cargo. Based on studies of aircraft parts transferred between bases in the past, estimates are that at least 90 percent of these parts would fit on an aircraft designed to carry the F100 engine. Emphasis is also placed on the ease of servicing and maintainability of the EDS aircraft. In striving for simplicity, the Air Force has requested an off-the-shelf aircraft with a proven record of airworthiness and maintainability. The final determinant is low acquisition and maintenance costs. The competition includes the cost of purchasing 18 aircraft in 1984, maintenance support for these aircraft for their lifetime, and options to purchase 46 additional aircraft during the next two years. Although the contract will be designed to minimize system cost, the aircraft must satisfy specific operational demands.

When the demands of war are applied to the EDS requirements, a specific type of aircraft begins to take shape. To overcome the obstacle of interdicted runways, the aircraft must be capable of short field operations on paved or unpaved surfaces, and this requirement translates to a capability of taking off with a 4,200-pound payload in 1,750 feet and landing in less than 1,500 feet. The maximum payload must exceed 5,000 pounds. Operated by a three-member crew, this multiengine turboprop will be capable of carrying a 2,800-pound load for 700 nautical miles, and it must cruise at 140 knots or better. Since the combat capability of many other aircraft will depend on the reliability of this aircraft, it must be capable

of on time departure at least 96 percent of the time, and turnaround time at bases en route must not exceed 30 minutes. The aircraft envisioned is a small, reliable, rugged airlifter similar in many respects to the old Caribou. In fact, when the Rand study examined the alternatives for building a European distribution system, one of the options was a modernized C-7. What are the implications of this distribution system for the future of theater airlift?

If assured distribution can deliver its promised improvements in theater logistics, then there is a great probability that its popularity will spread to other combat theaters. The advancement of warfighting capabilities through improved distribution blends well with the combat-oriented image recently developed by the Air Force Logistics Command. The command anticipated multitheater requirements and included options to purchase additional aircraft in the request for proposal. Other theater commanders are now studying the European distribution system with an eye toward application of the concept in their theaters. The implications are that this system has a great potential for growth and, as such, warrants careful management. If the system proves beneficial to Europe, it may well offer a universal benefit applicable to any theater. This development will introduce a need for a deployable CONUS-based theater distribution system capable of setting up and operating within designated theaters. Careful management will be needed for this potential expansion to insure a cost-effective and efficient system.

As the airlift operator for the Department of Defense, the Military Airlift Command will ultimately be tasked to train, deploy, and operate these systems. In the interest of airlift efficiency, these multiple systems must be standardized to the extent permitted by operational

requirements. If the missions and equipment are similar, then training, operating, and administering the systems will benefit from economies of scale. Should a surge require augmentation from one theater to another, similar systems would make this transition possible. In anticipation of a successful European system, the feasibility of multiple theater operations should be studied from the perspective of worldwide standardization. In this most unique role of the small cargo aircraft, both the innovator--Air Force Logistics Command--and the operator--Military Airlift Command--have a mutual stake in the efficient development of the system.

## CONCLUSION

Emphasis on expansion of airlift has been directed for many years toward procurement of larger aircraft, but the expense of buying and maintaining these systems has kept the fleet smaller than most experts deem necessary. In the process, the small airlift fleet has all but disappeared. The Research and Development Subcommittee of the House Committee on Armed Services expressed dismay in 1970 at the lack of effort to modernize the tactical airlift force and recommended replacement of the C-7 and C-123.[9] Perhaps recognition that small airlift aircraft can actually generate more sorties for the larger airlifters, coupled with the new requirement for a theater distribution system, will rekindle interest in this subject.

Small airlift aircraft can, in many cases, replace larger C-130 aircraft on low-use channel runs. This step would be most advantageous from the procurement standpoint, since the price of the small plane is less than one-fifth the price of the Hercules. And operating costs are much lower for the smaller aircraft. The C-130s would then augment the combat airlift

force. Unregulated commercial airlines have proven that the use of small aircraft to serve small markets is an economically rational concept. It also seems rational for the Military Airlift Command. Therefore, the command should first determine the channels that consistently underuse the C-130. It should then consider the cost effectiveness of using small aircraft to operate on these channel missions and request funding to procure these aircraft. In addition to generating tactical airlift sorties, a small airlifter can also enhance the flow of strategic airlift.

Strategic airlift is the umbilical cord of every theater deployment, but it consists of a limited number of large, expensive aircraft. A breakdown at some point in the flow causes problems throughout the system when resources are tightly scheduled. It is no longer economically feasible to move maintenance teams around the system in otherwise empty C-141s, and the diversion of additional aircraft from the flow only complicates problems caused by the original breakdown. Small airlift aircraft dedicated to MAC support can deliver these repair teams faster without additional diversions. To solve the problem, MAC planners must devise a method to track and analyze the frequency of diversions to support maintenance requirements and apply this data to wartime constraints. They must next forecast the number of diversions expected in combat, measure the feasibility of using the proposed small aircraft to satisfy these requirements, and request funding for the system on the basis of its cost effectiveness. Once again, the value of the small aircraft is not its small size but the number of large aircraft sorties it generates.

Just as the generation of fighter sorties led to the development of the European distribution system, the application of the same principles to other theaters may lead to further deployment of the concept. If the system

is so valuable in Europe, then theaters with minimal existing transport should benefit even more. At the center of this revolutionary concept of assured distribution is the small reliable cargo aircraft. The challenge to the Air Force in this case is to insure that the system is developed with efficient operations in mind as requirements expand from a single-theater concept to worldwide deployment. Innovators of the system at Air Force Logistics Command must continue to pursue similar programs and customers in every theater and insure that a unit whose combat power is multiplied in one theater is not degraded by the lack of assured distribution in another theater. MAC coordinators should follow these developments closely to insure that the system is ultimately designed for efficient airlift operations.

Now is the time to replace the Caribou. The three arguments leading to this conclusion do not suggest three fleets of small aircraft; they suggest one fleet with three distinct theater missions. This force may require more than the 64 aircraft in the original package, but, if the cost analyses require more, this is the time to determine the requirement. The Air Force must act while the contract is fresh and the infrastructure for the fleet is being assembled. Twenty-five years of technological development have produced a class of small but sure aircraft, the keystone of a new concept in theater logistics. Let us not miss the opportunity to rationalize theater airlift operations.

# FOOTNOTES

1. Hq USAF, AFSOA, Analysis of C123 and C130 Airframe Utilization in RVN, 1968, pp. 1-4.

2. Research & Development Subcommittee, House Committee on Armed Services, The Posture of Military Airlift, 94th Congress, 1st Session, 1975, p. 69.

3. Military Airlift Command, Transportation Directorate, "Channel Productivity Improvement Report," July, August, September 1983.

4. US Congressional Budget Office, US Airlift Forces: Enhancement Alternatives for NATO and Non-NATO Contingencies, April 1979, p. 15.

5. Rand Corporation (Project AIR FORCE), Capabilities for Military Airlift to Third Areas: 1978 and Mid 1980s, 1979, p. 20.

6. Rand Corporation, Vulnerability of Strategic Airlift Operations in Reinforcing NATO, 1978, p. 40.

7. Rand Corporation, Combat Benefits of a Responsive Logistics Transportation System for the European Theater, 1981.

8. Hq AFSC/ASD, "European Distribution System Aircraft (EDSA)," Request for Proposal, 17 July 1983, p. 35.

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